AD-768 638

QUARTERLY TECHNICAL SUMMARY REPORT, APRIL-JUNE 1973

Robert R. Blandford

Teledyne Geotech

Prepared for:

Advanced Research Projects Agency
Air Force Technical Applications Center

17 July 1973

Unclassified
Security Classification

AD 768638

DOCUMENT CONTROL DATA - R&D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1 ORIGINATING ACTIVITY (Corporate author)

Teledyne Geotech
Alexandria, Virginia

2a REPORT SECURITY CLASSIFICATION

Unclassified

2b GROUP

3 REPORT TITLE

SEISMIC DATA LABORATORY QUARTERLY TECHNICAL SUMMARY REPORT
APRIL-JUNE 1973

4 DESCRIPTIVE NOTES (Type of report and inclusive dates)

Scientific

5 AUTHOR(S) (Last name, first name, initial)

Blandford, Robert R.

6 REPORT DATE	7a TOTAL NO OF PAGES	7b NO OF REFS
17 July 1973	14	

8a CONTRACT OR GRANT NO.	9a ORIGINATOR'S REPORT NUMBER(S)
F33657-72-C-0009 b PROJECT NO VELA T/2706 c ARPA Order No. 1714 dARPA Program Code No. 2F10	9b OTHER REPORT NO(S) (Any other numbers that may be assigned this report)

10 AVAILABILITY/LIMITATION NOTICES

11 SUPPLEMENTARY NOTES	12 SPONSORING MILITARY ACTIVITY
	Advanced Research Projects Agency Nuclear Monitoring Research Office Washington, D. C.

13 ABSTRACT

This report summarizes the work done by the SDL during the period April through June 1973, and primarily concerns the seismic research activities related to the detection and identification of nuclear explosions and earthquakes. The report also contains brief discussions of the support tasks and data services which were performed for other government contractors and for participants in the VELA-UNIFORM and PRIME ARGUS projects.

14 KEY WORDS

Seismic Data Laboratory - Quarterly
Technical Summary
VELA-UNIFORM Project

Unclassified
Security Classification

SEISMIC DATA LABORATORY

QUARTERLY TECHNICAL SUMMARY REPORT

April - June 1973

AFTAC Project No.:	VELA T/2706
Project Title:	Seismic Data Laboratory
ARPA Order No.:	1714
ARPA Program Code No.:	2F-10
Name of Contractor:	TELEDYNE GEOTECH
Contract No.:	F33657-72-C-0009
Date of Contract:	01 July 1971
Amount of Contract:	$2,482,460
Contract Expiration Date:	30 June 1973
Project Manager:	Robert R. Blandford (703) 836-3882

P.O. Box 334, Alexandria, Virginia 22313

ic

TABLE OF CONTENTS

ABSTRACT

This report summarizes the work done by the SDL during the period April through June 1973, and primarily concerns the seismic research activities related to the detection and identification of nuclear explosions and earthquakes. The report also contains brief discussions of the support tasks and data services which were performed for other government contractors and for participants in the VELA-UNIFORM and PRIME ARGUS projects.

I. INTRODUCTION

This quarterly report summarizes the technical work, support effort, and data services completed during the period April through June 1973.

Reviews of technical reports completed during the reporting period are contained in Section II under descriptive headings. Section III is a summary of the support and service tasks performed for other government contractors for VELA-UNIFORM and PRIME ARGUS participants.

The engineering study of seismic arrays, SDL Report 304, has been distributed in accordance with instructions from VSC.

II. WORK COMPLETED

A. M_s - m_b Characteristics of Earthquakes in the Eastern Himalayan Region - No. 296

The results of a study of M_s vs m_b characteristics of earthquakes in the Eastern Himalayan region are given in this report. It is shown that in this region some earthquakes occur which have M_s vs m_b characteristics similar to explosions, exhibiting low surface wave magnitudes relative to body wave magnitudes, when seen at the reporting stations available to this study. The application of station corrections does not change the general distribution and spread of points in the M_s vs m_b plane, and therefore it is unlikely that station (or path) effects

are the source of the anomalies. Focal depths of most of the events studied are shallow or normal and can also be ruled out as causes of low surface wave magnitudes. The geographical distribution of anomalous events correlates with various prominent geological features and probably reflects the distribution of tectonic stress in the area studied. The existence of these anomalous events in certain areas of the world decreases the effectiveness of the M_s vs m_b criterion in discriminating between earthquakes and explosions. Detection of the Rayleigh wave from these events is so difficult that further understanding of their mechanism is dependent on an improved monitoring capability with good azimuthal coverage.

B. P and PKP Coda Decay Characteristics for Earthquakes - No. 301

P and PKP coda characteristics are determined for earthquakes from 15 seismic regions as recorded at 17 World Wide Standard Seismograph Stations (WWSSS). In determining the coda characteristics for an event, amplitude measurements scaled relative to the largest excursion in the coda, are made in successive time windows, and the coda envelope obtained by connecting successive observations. The individual coda, average coda, and standard deviations about the average coda as a function of time into the coda (in units of m_b) are given for each set of

measurements. The coda for events in a given region recorded at a given distance are found to be very similar to the coda for events from another region recorded at the same distance. That is, coda characteristics are determined primarily by the arrival times and amplitude of significant secondary phases. Further, the coda characteristics determined for large events ($6.0 \lesssim m_b \lesssim 7.0$) appear applicable to smaller events ($5.0 \lesssim m_b \lesssim 6.0$) as well. Using data in the range $45° < \Delta < 80°$, the long-term P-coda decay constant λ for elapsed times greater than four minutes is .0017 per second ($e^{-\lambda t}$). In the range $80° < \Delta < 105°$, the decay constant is somewhat larger, being on the order of .0037 per second.

C. Long Period Rayleigh Waves from Earthquakes and Explosions - No. 307

Comparisons are made of Rayleigh wave spectra for NTS explosions and Nevada earthquakes and for a limited number of teleseismic explosions and earthquakes recorded in North America. For a given combination of source and receiver location, the explosions consistently exhibit the same spectral shape over a significant range of magnitudes while spectral shapes for earthquakes commonly vary in a manner that appears independent of magnitude, with some earthquake shapes closely matching those of explosions. The spectral shapes for explosions were commonly observed to vary significantly from station to station at

comparable distance ranges, probably because of path and receiver site effects. We conclude that neither Rayleigh spectral shape nor symmetry of raw surface wave radiation patterns is likely to be a reliable discriminant in general.

III. SUPPORT AND SERVICE TASKS

In addition to the research studies discussed above the SDL completed the following support and service tasks:

A. Data Cataloging, Classifying and Retrieval

The library consists of seismograph data from the LRSM sites, the observatories LASA, TFO, UBO, WMO, BMO, CPO and additional data from other sources. The corresponding operational logs are also included in the library.

At the end of June 1973, the library contained approximately:

35,107	analog magnetic tapes
21,140	digitized seismograms
5,666	digital magnetic tapes

Fifty-four digital tapes have been assigned to the HDT Project. The library also contained seismographic data on 16 mm and 35 mm film. Those are commonly from simultaneous recording of tape and film data at the observatories and the LRSM sites.

The following categories of digital tapes are in the library:

281	UBO multiplexed
1,199	LASA multiplexed
918	TFO long period (DGRADAS tapes)
624	TFO short period (ASDAS tapes)
2,055	Library tapes (A/D and D/D conversions)
826	Permanent save tapes
1,636	Operations tapes (scratch, save, etc.)

The analog tape library contains:

9,305	Compressed tapes
332	Composites
17,554	Tapes saved as recorded (not compressed)
8,099	Tapes scheduled for compression as time permits

B. Equipment Modification

An error in design logic was uncovered in the VT-15 display processor. The hardware was wired as designed but apparently not designed to be used as specified in the VT-15 Graphics reference manual (DEC-15-GWSB-D). DEC was informed of this discrepancy and has since rewired the display processor to allow the user to enable and disable the light pen activity as specified in the above referenced manual.

C. Maintain and Operate Equipment

Because of a delay in the delivery of the

BUCODE 9-track, 1600 BPI tape drives, the equipment reconfiguration discussed in the Monthly Progress Report for May 1973 was rescheduled for 16 and 17 July.

Delivery of the BUCODE tape drives has been now rescheduled for 16 July.

A bad module was uncovered and replaced in the floating point processor. This module caused a malfunction in the set "A SIGN" positive micro coded instruction. This problem was not indicated during the running of the DEC supplied floating point hardware diagnostic routines.

D. Digital Programming

As a result of the problem discussed in "B" above progress on the SWAP01 software system was delayed approximately 8 days. A further delay of approximately 3 days was encountered because of the second problem mentioned in "C" above. This problem caused the following library routines to malfunction: DABS (double precision absolute value), SIGN (transfer of sign), JSIGN (double integer transfer of sign), DSIGN (double precision transfer of sign), DSIN (double precision sine), DCOS (double precision cosine). Approximately 95% of the coding effort on the DPMN Phase of SWAP01 is completed and this phase is now in the final debug stage. This phase should be completed by 18 July. As a result of re-evaluation of

hardware, software, design and coding problems we now estimate the visibility date of the SWAP01 software system to be late August 1973.

The Calcomp plotting package has been fully evaluated and debugged and is now ready for operation. There still exists a problem in reading tapes generated on the 360/44 tape drives. The PDP-15 drives are apparently detecting parity errors on each read of the tape. This problem will be resolved as soon as possible.

Varian did not meet the 10 June delivery date for the Varian printer plotter Data Plot II software. At this time we have requested another projected delivery date.

The bid from DEC on the RSX compatible Varian handler has been received. We are now trying to determine if and when we want to purchase the above software. This decision will be based in part on decisions made concerning the Varian hardware.

E. VELA and PRIME ARGUS DATA Copies

During the past year SDL supplied data or computer services to the following:

ACDA, Department of State, Washington D. C.
Air Force Cambridge Research Laboratory
Air Force Office of Scientific Research
Commonwealth of Australia, Dept. of Natl. Devlopment
Dept. of Energy, Mines, and Resources, Ottawa, Canada
General Atronics Corporation
IBM

Institute of Geological Sciences, Great Britain
Lawrence Livermore Laboratories
Los Alamos Scientific Laboratory
MIT, Lincoln Laboratory
Naval Research Laboratory, Washington, D. C.
National Park Service
Royal Norwegian Council for Scientific and Industrial Research
Texas Instruments
Teledyne Geotech, Garland, Texas
U. S. Dept. of Commerce, National Oceanic and Atmospheric Administration
U. S. Dept. of Interior, Geological Survey

California Institute of Technology
Georgia Institute of Technology
Institute of Geophysics, Victoria University
MIT, Lincoln Laboratory
New Mexico Institute of Mining and Technology
Oregon State University
Pennsylvania State University
St. Louis University
Southern Methodist University
University of Alaska
University of California, Berkeley
University of California, San Diego
University of Edinburgh
University of Hawaii
Universitie Louis Pasteur
University of Minnesota
University of Oklahoma
University of Texas at Dallas
University of Utrecht
University of Washington at Seattle
University of Wisconsin

F. Analog Field Tape Supply

As a result of compression 683 tapes are available to be shipped for field use. No compression was done in June.

G. Array Data Service

During June, requests for 98 samples of NORSAR short period data were made, 56 were received from Norway. As of the end of May the SAAC/LASA w ekly summary was being mailed to 30 recipients.